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APPENDIX A

HABITAT EVALUATION AND QUANTIFICATION

PEKIN LAKE STATE FISH AND WILDLIFE AREA
SOUTHERN UNIT
CRITICAL RESTORATION PROJECT
ILLINOIS RIVER ECOSYSTEM RESTORATION STUDY, ILLINOIS

August 2004

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1. INTRODUCTION

A habitat analysis was conducted to evaluate potential benefits of habitat improvement features for the Pekin Lake State Fish and Wildlife Area (SFWA) Illinois River Ecosystem Restoration Study. Active participants included biologists from the Rock Island District of the U.S. Army Corps of Engineers (Corps), US Fish and Wildlife Service (U.S. FWS), and the Illinois Department of Natural Resources (IDNR). The team used a modified form of the Habitat Evaluation Procedure (HEP) program called EXHEP (EXpert Habitat Evaluation Procedures).

The benefits to be derived from habitat restoration projects are not readily convertible to actual monetary units as is customarily required for traditional projects utilizing benefit-cost analyses. A method of quantification is needed to adequately evaluate project features. Quantification of habitat restoration project outputs can then be utilized as a project performance evaluation tool, a project-ranking tool, and/or a project-planning tool. This application for project output quantification was used as a project-planning tool.

While the cost to create an acre of a particular habitat type can be measured, the number of species that will eventually utilize that acre and the quality of habitat that develops on any created acre of habitat is difficult to ascertain. One way to measure habitat is to use Habitat Evaluation Procedures (HEP). The HEP quantifies project outputs expressed in habitat units (HUs). An HU is equal to habitat **quality** (habitat suitability indices, or HSI) multiplied by habitat **quantity** (area). This index varies from zero to one and measures how suitable the habitat is for a selected species when compared to that species' *optimum* habitat. Annualized HUs can then be used to determine changes brought about by project features/alternatives over time. This annualization computes average annual habitat units (AAHUs).

Once construction begins and as a project matures, habitat changes occur, and therefore habitat benefits may change. Many features (e.g., tree planting/growth) may not begin to show significant benefits until well into a project's life. The particular dynamics of the ecosystem under study then help determine the target years chosen for analysis. With or without a project, habitat conditions generally change over time; therefore, the overall value of a proposed project depends upon the comparison of "with-project" benefits and "without-project" benefits.

Comparison of alternative designs and combinations of features is accomplished through cost-effectiveness evaluation and incremental analysis. Cost-effectiveness evaluation is used to identify the least costly solution to achieve a range of project benefits. Incremental cost analysis is a tool that can be used to scale the size of the project or of individual features by determining changes in cost associated with increasing levels of benefits.

2. HABITAT EVALUATION METHODOLOGY

The methodology used in this evaluation was a modified form of HEP, the Expert Habitat Evaluation Process or EXHEP. HEP models were developed to aid in land management planning, and require the selection and evaluation of a variety of target species for each computer-generated evaluation. The EXHEP program takes a rather specific approach and evaluates target species that are assumed to be representative of habitat quality. EXHEP also evaluates a broad range of target years for each species within a specified habitat type. By doing this, habitat benefits gained and/or lost throughout the life of the project can be shown.

EXHEP is a Microsoft Access© '97 package developed by the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC - formerly Waterways Experiment Station) in Vicksburg, Mississippi, to automate standard HEP calculations and facilitates large-scale HEP assessments efficiently and effectively. EXHEP uses Microsoft® Windows-compatible programming to: (1) solve complex mathematical calculations quickly and (2) provide a highly intuitive, visual interface to facilitate communication between the system and the user. As with any sophisticated mathematical evaluation, a well-tested, efficiently written, standard software package is a critical tool that saves time and improves the reliability and repeatability of the results. However, this software cannot replace the user's understanding of the conceptual basis of HEP, or its application to the decision making process. EXHEP should not be viewed as the end-all means to provide the only predictive environmental response to project development. Rather, the program should be viewed as a tool that can provide a rational, supportable, focused, and traceable evaluation of environmental effects.

EXHEP was designed to process a large amount of data quickly and efficiently, handling a large number of HSI (Habitat Suitability Index) models simultaneously. Each HSI model can incorporate any number of cover types. Each cover type can include a large number of variables, and the user can incorporate as many life requisites within each model as necessary. These capabilities support the examination of complex studies with large numbers of permutations. In some studies, it is not unusual to evaluate 10-15 HSI models (with more than 25 cover types) in an attempt to describe complex interrelationships within the ecosystem. The staggering amount of tedious mathematical calculations necessary to compute HEP at this level requires a powerful tool to evaluate environmental output. EXHEP, enhanced by its ability to communicate these activities in an organized fashion, can quickly accomplish this task. The number of permutations, processing speed, and EXHEP performance are limited only by the capacity of the user's hardware, where data storage becomes the limiting factor.

EXHEP is a species-driven evaluation process that involves mathematical associations between environmental cover types and the individual variables that compose each of those cover types. During the evaluation process, each variable of a cover type was calculated on a 0.1 to 1.0 index. This evaluation was done using suitability graphs created by the FWS for the Habitat Suitability Index Models Series. This series was researched and created by the FWS to provide habitat information useful for impact assessment and habitat management. The variable suitability outcomes were then inserted into a Habitat Suitability Equation (also taken from the WS Habitat Suitability Series). The Habitat Suitability Equation is an evaluation that combines all Life Requisites of the specified wildlife and designates it a suitability index number. This final suitability number was then used to calculate final with- and without-project AAHUs.

The HEP Team was facilitated by the professional biological opinions of Corps staff. For the evaluation process, the study team reviewed aerial photography, GIS and topographic data, and preliminary design drawings. The members of the team were also familiar with the project area and the IDNR staff had direct knowledge of existing conditions within Pekin Lake SFWA.

The main objective of the proposed project is to provide diverse deep and shallow-water aquatic habitat, curtail willow invasion and improve the riparian forestry component by providing elevations consistent with the production of mast trees within the southern unit of the Pekin Lake SFWA.

3. EVALUATION SPECIES SELECTION

Several habitat types represented by species-driven HSI models were evaluated in this document. Although a particular species is used, each species represents required habitat for many other similar species that utilize the same habitat in similar ways. In essence, each species represents an array of habitat variables for the species being evaluated. These species represent key goals and objectives for the development of specific habitat types proposed by the project.

The use of this information is required to derive quantitative relationships between key environmental variables and habitat suitability within the immediate study area. This document provides a foundation for the HEP application for the selected species-based HSI models. The HSI models selected for the project were: bluegill (*Lepomis macrochirus*), great blue heron (*Ardea herodias*), marsh wren (*Cistothorus palustri*), (modified marsh wren model), muskrat (*Ondatra zibethicus*), and wood duck (*Aix sponsa*). Table A-1 shows the selected species with applicable cover types and associated variables.

The bluegill is an opportunistic feeder that is most abundant along shoreline areas with low velocity water. While they are usually found in shallower water (3-9 feet), they require deep water (6 foot or greater) for overwintering and retreat from summer heat. The winter model modification was included in the HEP for bluegill. This modified model included criteria for backwater water depths and winter dissolved oxygen.

The great blue heron forages primarily in shallow (20 inches or less) open water, but may also forage in areas of emergent vegetation. Fish are the preferred food item, however frogs and toads, tadpoles and newts, snakes, lizards, rodents and other small mammals, birds, insects, crayfish, and snails have all been reported as dietary items. Social feeding occurs with nesting colonies and is done usually within 2-4 miles of the colony, but may occur as far away as 18 miles from the colony.

The marsh wren is an abundant breeding bird species of freshwater and saltwater marshes and requires emergent vegetation with shallow standing water. They feed on various insects that marshy areas support and use water isolation to protect their nests.

The muskrat is the most valuable semi-aquatic furbearing mammal in North America. Muskrats are primarily herbivores and while cattails are a preferred food, they will utilize the most available plant species in the area they populate. Muskrats may construct conical lodges or burrows in banks adjacent to aquatic habitats. They require permanent water of still or low velocity and prefer a water depth of 18 inches to 4 feet.

The wood duck is a waterfowl found around wetland areas with open water and nests in tree cavities or nest boxes. Wood ducks are primarily herbivores but invertebrates may make up a significant part of their diet. Wood ducks prefer to forage for mast in areas of shallow water (up to 18 inches deep) or on the forest floor.

TABLE A-1.
Species Selected (With Applicable Cover Types and Variable Associations)

PEKIN LAKE PROJECT SITE		
Species	**Cover types**	**Associated variables**
Blue Gill	Lake	Percent Cover (Debris)
		Percent Cover (Vegetation)
		Percent Littoral Area During Summer Stratification
		Percent TDS Level During Growing Season
		Max Monthly Average Turbidity
		pH Range During Growing Season
		Min Dissolved Oxygen Range During Summer
		Max Monthly Average Salinity During Growing Season
		Max Midsummer Temperature
		Average of Mean Weekly Water Temp
		Max Early Summer Temp
		Max Midsummer Temp
		Reservoir Drawdown During Spawning
		Substrate Composition During Spawning
	Over Winter	Backwater Water Depths
		Winter Dissolved Oxygen
Great Blue Heron	Forested Wetland	Distance Between Potential Nest Sites And Foraging Areas
		Presence Of Water Body With Suitable Prey Population And Foraging Substrate
		Disturbance-Free Zone Up To 100 m Around Potential Foraging Area
		Presence Of Treeland Cover Types Within 250 m Of Wetland (Nest Trees)
		Presence Of 250 m (Land) Or 150 m (Water) Disturbance-Free Zone Around Potential Nest Sites
		Proximity Of Potential Nest Site To An Active Nest Site
	Herbaceous Wetland	Distance Between Potential Nest Sites And Foraging Areas
		Presence Of Water Body With Suitable Prey Population And Foraging Substrate
		Disturbance-Free Zone Up To 100 m Around Potential Foraging Area
Marsh Wren/Emergent	PEM*	Percent Emergent Canopy
		Classification of Plant Growthform
		Percent Tree and Shrub Canopy
		Mean Water Depth
	PSS**	Percent Emergent Canopy
		Classification of Plant Growthform
		Percent Tree and Shrub Canopy
		Mean Water Depth
Muskrat	Herbaceous Wetland	Percent Emergent Canopy
		Percent Year Surface Water
		Percent Emergent bulrush or cattail
Wood Duck	Forested Wetland	Percent Tree and Shrub Canopy
		Percent Of Water Surface Covered By Potential Brood Cover
		Percent Of Water Surface Covered By Potential Winter Cover

*PEM=Palustrine Emergent Wetland
**PSS=Palustrine Scrub Shrub Wetland

4. ASSUMPTIONS

Assumptions have been made regarding current conditions, model performance, and changes in habitat conditions over time. These assumptions are made using best available data.

a. Current Conditions. Management of the site is currently passive. If continued, the site would degrade at a fairly rapid rate. The IDNR has recently proposed a more active management strategy for the site. However, it is unlikely that it would be as ambitious as the management possibilities made likely by this proposed project and state project funding is always an issue to consider. Therefore future conditions without project would fare only slightly better even if the IDNR's management plan were enacted. For that reason, discussion of future conditions assumes that there would be no, or only minimal change in the current management policies for the Pekin Lake SFWA.

b. Model Performance. The quantitative component of the EXHEP analysis is the measure of the acres of habitat that are available for the selected species. From the qualitative and quantitative determinations, the standard unit of measure, the HU, was calculated using the formula (HSI x Acres = HUs). For project planning and impact analysis, project life was established as 50 years. To facilitate comparison, target years were established at 0 (existing conditions), 1 year after, 5 years after, 20 years after, and 50 years after project construction. HSI and AAHUs for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

c. Changes in Habitat Conditions Over Time. Habitat conditions are not usually static. Either through natural processes or human activity, habitat generally evolves and may change in quality and/or quantity. Imbedded in each cover type evaluation, change has been added to the model. To assess the change over the period of analysis, target years have been defined. At each target year, a change in the habitat variables may be noticed. Noticeable changes can be characterized by a change in habitat benefit output.

d. Model Assumptions/Modifications.

- Without Project Acreages were calculated using a 0.3 in/yr siltation rate and assuming an even transition between covertypes of 1.5% a year.
- Baseline acreages (approximately 390) were calculated from vegetation map created during site visit and elevations 8-9-01. (Federal and state representatives present)
- Baseline acres include: Shallow open water = 29.2 acres; Moist soil/emergent = 218.4 acres; Scrub shrub = 130.1 acres; Forested = 304.2.

Southern Unit

- Shallow water = 26.2 acres
- Moist soil emergent = 174.6 acres
- Scrub shrub = 89.4 acres
- Forested = 99.9 acres

Bluegill

- Variable V4 was modified to read 'Percent littoral area during summer stratification (area that is 4ft or greater in depth)'. This change was based on the Suitability model published by the St. Paul District (MVP) Corps of Engineers (January 1990). The MVP revised the original Bluegill model to incorporate over wintering limitations of littoral habitats.

Great Blue Heron

- Current degradation of Pekin Lake Heron habitat would continue over life of the project at the rate previously mentioned.

- Prey availability would increase although actual water may not increase. Improved water quality and deeper aquatic habitat would encourage more spawning and presence of prey.
- Critical feeding times are during nesting and when fledglings come off nest.
- Area is posted as no entrance during the times that are most critical to be free from human disturbance.
- It is assumed that alternatives that include fingers of deeper water would allow boaters more access and probably create more disturbance than alternatives without.

Wood Duck

- Initially it was assumed that the nesting component of this model consisted of a suitability of 0.18. This number is a calculation of nesting trees and nest boxes on site. Upon further investigation, it was found that the number of nesting trees was probably higher than originally assumed and therefore this number was raised to 0.22 for TY 5 and 20, and raised to 0.27 for TY 50.
- Although it is understood that this number is the limiting factor for the model, the HEP team decided that these numbers fairly represent the conditions at Pekin Lake SFWA for both baseline and future with conditions.

Muskrat

- Percent cattail and/or Olney and common three square bulrush species criteria was increased to include a more diverse range of plants. This was done through professional judgment of project biologist. Plant diversity now includes arrowhead, nut sedge, and other/any species of bulrush.

Marsh Wren/Emergent Model

- This model was created to assess the habitat benefits of this project as it pertains to the moist soil/emergent category.
- The premise of this model is based off the Marsh Wren blue book published by the FWS.
- This model was used to link hydrograph data to the mathematical equations of the Marsh Wren model to produce a HEP suitability of emergent/moist soil cover type.
- It is assumed (using the following comments) that this model would do an effective job of capturing the quality and quantity of the emergent/moist soil cover types.
    1. There would be a shift in moist soil components between mid and late summer. From late summer to mid-fall, plants with rigid stems would be selected for continued presence with higher water levels as a result of waterfowl management.
    2. Emergent vegetation may develop if mid-summer water levels in the upper pool remain stable for 2 to 3 years during the growing season. Other static water areas in the immediate vicinity host populations of lotus and cattail. It would be reasonable to assume that these plants would be available in year 2 or 3 of the project.
    3. The moist soil component should be available from year 1 for desired species.
    4. All species anticipated to grow on site are fairly desirable moist soil vegetation except cocklebur.

5. RESULTS OF HABITAT ANALYSIS

This section describes the benefits in AAHUs for the proposed project. The alternatives considered for the proposed project were S0 through S6 (S5 being the preferred alternative). Complete details of the alternatives evaluated can be found in the main report in **Section 2 - Plan Formulation** under the heading *Identify Measures and Formulate Alternative Plans*. The preferred alternative (**S5**) would provide improved water quality by adding depth diversity and overwintering aquatic habitat. In addition, it would improve riparian habitat and promote mast tree production in the lower lakes.

Project Alternatives:

TABLE A-2.
Habitat Units by Plan (Gain or Loss)
(*Preferred Alternative)

SPECIES	***S0***	***S1***	***S2***	***S3***	***S4***	***S5****	***S6***
Emergent (Marsh wren)	0	-0.2	-0.2	-0.1	-0.1	**-0.1**	-0.1
Great Blue Heron	0	-2.1	0.6	1.6	3.4	**1.4**	1.2
Bluegill*	**0**	**2**	**8.2**	**8.2**	**14.2**	**14**	**12.5**
Muskrat	0	-1	-0.4	-0.2	-0.2	**-0.2**	-0.3
Wood Duck	0	0.2	-0.2	0.2	-0.3	**-0.1**	-0.3
Total	0	-1.1	8.0	9.7	17.0	**15.0**	13.0

** Primary target species for project

S0- No Action Alternative.
S1 –Deep channels only with placement at Sites B & E and Island C3 (base plan).
S2 – Base plan with channel g-h, deep hole (7) and shallow areas (1, 2, 5, and 6) and additional placement at Site A and islands C1, C2, C4 and C5.
S3 - Base plan with channel g-h, deep hole (7) and shallow areas (1, 2, 5, and 6) and additional placement at Site B and islands C1, C2, C4 and C5.
S4 - Base plan with channel g-h, deep holes (7 and 4) and shallow areas (1, 2, 3, 5, and 6) and additional placement at Sites A and B and islands C1, C2, C4 and C5.
S5 - Base plan with channel g-h, deep holes (7 and 4) and shallow areas (1, 2, 3, 5, and 6) and additional placement at Site B and islands C1, C2, C4 and C5 (preferred alternative).
S6 - Base plan with channel g-h, deep holes (7 and 4) and shallow areas (1, 2, 3, 5, and 6) and additional placement at Sites A and B and islands C1, C2, C4 and C5.

Complete details of the alternatives evaluated can be found in the main report for the Southern Unit in **Section 2 - Plan Formulation** under the heading *Identify Measures and Formulate Alternative Plans*.

The proposed selected alternative for the Southern Unit (S5) would provide deep and shallow backwater fisheries habitat, small backwater islands, improved riparian areas, and promote mast tree growth in selected areas.

The habitat evaluation process utilized two types of species models: the single life requisite model (SM or sometimes LR) and the multiple life requisite model (MM). The multiple life requisite model looks at a species using more than one habitat feature that is required for different life stages. The overall outputs for the models selected show that the proposed project would provide a total of 15 AAHUs. A breakdown of the model outputs for the proposed plan is shown in Table A-3. A summary of individual species outputs for all alternatives considered can be found in table A-2.

TABLE A-3.
Overall Model Outputs
(Proposed plan)

Model	Type of Model (SM / MM)*	Southern Unit AAHUs
Marsh Wren/Emergent	SM	-0.1
Great Blue Heron	SM	1.4
Bluegill	MM	14
Muskrat	SM	-0.2
Wood Duck	MM	-0.1

*SM= single life requisite model
MM= multiple life requisite model

After the environmental outputs and annualized costs were calculated, the incremental analysis of alternatives was completed.

6. INCREMENTAL ANALYSIS OF ALTERNATIVES

Changes in the quality and/or quantity of HUs occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HU derived over the life of the project. Cumulative HUs are annualized and averaged. This determines what is known as the AAHU. AAHUs are used as an output measurement to compare all the features and project as a whole.

Rough cost estimates were developed for project components to conduct the cost effectiveness and incremental cost analysis of the various alternative plans. The results of the cost effectiveness analysis for the alternative plans (Table A-4) showed that S0, S3, S5, & S6 were all cost effective plans. The No Action Alternative is always cost effective. Cost effectiveness means that no plan can provide the same benefits for less cost or more benefits for the same cost. Alternative S4 exhibited the lowest cost per unit of all alternatives, $29,163 per AAHU. Alternative S3 exhibited the highest cost per unit of all alternatives, $33,430 per AAHU.

TABLE A-4
Alternative Plan Evaluation

Alt. Plans	AAHU Output	Annualized Cost	Annualized Cost/AAHU
S0	0.0	$0	$0
S1	2.0	$140,570	$154,627
S2	8.2	$330,757	$41,344
S3	8.2	$324,277	$33,430
S4	14.2	$495,772	$29,163
S5	14.0	$455,400	$30,360
S6	12.5	$460,865	$35,447

Overall, alternative plans S0 and S4 were considered best buy plans. However, alternative plan S4 exceeds the Federal per project limit specified under the Section 519 authority. Therefore, alternatives S0, S3, and S5 were carried forward into an incremental cost analyses. These plans provide the greatest increase in benefits for the least increase in costs. Alternative plan S3 provides 9.7 AAHUs at an annualized incremental cost of $33,430 per AAHU (Table 4-5). Alternative plan S5 provides additional AAHUs, over and above , at an annualized incremental cost of $24,740.

Table 4-5 Incremental Cost Analysis of Best Buy Alternative Plans for Southern Unit

Alt. Plans	AAHU Output **	Annualized Cost *	Annualized Cost/AAHU	Inc. Cost	Inc. Output	Inc. $/AAHU
S0	0	$0	$0	$0	0	$0
S3	9.7	$324,277	$33,430	$324,277	9.7	$33,430
S5	15	$455,400	$30,360	$131,123	5.3	$24,740

* Annualized cost is initial construction cost based on a 50-year project life, 5-5/8% interest rate.
** Outputs are calculated as Average Annual Habitat Units (AAHUs).

7. DISCUSSION

This section interprets the numerical results of the analysis into a narrative format that will provide insight as to how the numbers were derived and what they mean in terms of the predicted outcome of the project. [All EXHEP field data sheets and output sheets are on file at the Rock Island District.]

Results of the evaluation for the proposed alternatives were compared as increments to costs associated with the implementation of each alternative plan. This incremental cost analysis is discussed above and in Section 2 of the main report under "Results of Incremental Cost/Cost Effectiveness Analysis."

While bottomland hardwood forest along the Illinois River is desirable habitat, trading backwater lake and marsh habitat within the wildlife area for woodland is not desirable. This is because the conversion of open water and emergent wetlands to scrub shrub reduces diversity of the river system. Therefore, if the enhancements proposed by this project can slow or even reverse the conversion of open water and emergent habitat to scrub shrub and forest habitat that has occurred over the last several years, it would be worthwhile to preserve and/or enhance this valuable resource. To accomplish that, the Corps and project sponsor, the IDNR, have determined that intervention is required. The question then becomes, how much work is required to get the best value for the money spent to restore Pekin Lake SFWA. One of the tools used to aid in selecting the preferred alternative is the HEP.

Within the program various life requisites and variables are looked at. Some of the items considered are emergent vegetation and feeding areas; mast trees, shrub and tree canopy covers; water level fluctuations; water clarity and amount of suitable water depth; potential brood cover and much more. The complete list can be found in table A-1, in Section 3 earlier in this appendix.

Also, because the values of the habitat evaluated fluctuate over time, the HSI values vary as the target years are examined. Trees that are expected to develop in some of the areas take time to grow and mature. Therefore early on, the HUs for those areas are relatively small. Another item that takes time is the conversion of shallow water to scrub shrub. While this is one of the developments that the project is trying to rectify, it will still happen in some areas and is quantified. Over time the habitat of the project area would change as the ecosystem develops. This maturing of the project's habitat is reflected in the HEP numbers by the increase and/or decrease of HUs over time.

In a few cases, HUs increase over time then level out or begin to decline. This indicates that the cover type or habitat that has established for a particular species has been optimized or limited in some way; or the cover type would not provide any further improvement. This may arise because of limitations in the plan (i.e. size of project) or other changes that occur naturally over time (e.g. vegetation maturing and dying out). Some of this may be the result of other more aggressive species stalling the spread of other less aggressive species or actually reducing an area of a particular cover type (willows converting moist soil plants).

A way to even out the HU's over the life of a project is to annualize the habitat units. By annualizing these values, an AAHU can be found and used in the calculation for the cost of the project over time. These changes depend on species requirements and what is determined to be an appropriate succession or evolution for the project and its components for future conditions.

The habitat evaluation results showed that this project generated relatively stable HSI values for target species over the project life. A slight increase in AAHUs was produced for the great blue heron in the preferred alternative while a slightly higher number was generated by alternative S4. This is likely because both alternatives improve fisheries habitat by improving water quality and increase fish survival during summer low water events, thus providing more food for the heron population located there. However, because S4 places material within the riparian area at Site A, it produces less direct impact to the actual size of the feeding area that the heron might utilize and thus generates a slightly higher value.

While it was hoped that the project would generate more positive benefits for marsh wren and muskrat, the negative values generated reflect the project's bias for deeper aquatic habitat. While the area currently provides minor habitat for species like these, during high or low water extremes that habitat is lost. Because the HSI model looks at average water depth for an area, it appears that the site would provide good habitat for these species most of the time. The reality is that because the water level fluctuations so severely within the SFWA, many times there is either too much water or not enough to meet these species requirements. While modification of the marsh wren model was made to allow it to more adequately represent key conditions for moist soils by tying it to water level fluctuations, which worked with the upper unit project, the lack of water control in the lower unit did not allow it to function as well for the southern unit project.

The wood duck model evaluates available forestry habitat. Since a large component of the proposed project reduces woody willow invasion, the impacts from terrestrial placement caused a minor reduction in benefits for this species. It was thought that the production of improved future riparian forest would provide additional benefits; but a larger tract of forest is required before the model will generate a significant increase in benefits for the wood duck.

Overall, the decrease in habitat benefits the analysis showed for the marsh wren, muskrat and wood duck were extremely minor. The numbers produced generally showed a loss of less than 0.5 HU for any of the alternatives with the average loss at 0.2 HU.

On the other hand, the analysis showed that the project generated significant habitat benefits for the target species, the bluegill. The base plan, S1 produced 2 HUs just by providing deep-water channels at the site. Alternatives S2 and S3 provided the same amount of shelf diversity and therefore produced the same 8.2 HUs for each alternative. S4 produced the greatest benefits with 14.2 HUs, but at greater project cost. The preferred alternative, S5 produced nearly as many benefits as S4 with 14 HUs and S6 at nearly the same cost as S5 produced fewer benefits (and less dredging) with 12.5 HUs. Essentially what the analysis showed was that more dredging produced more habitat benefits for the target species.

In conclusion, the preferred alternative is considered the best alternative to meet all of the evaluation criteria, it meets the sponsor's requirements, it follows Corps guidelines for project development, and the HEP evaluation showed that the project produce positive benefits for the environment.